THE LURE OF MEDICAL HISTORY*

JOHANN SIGISMUND ELSHOLTZ (1623–1688)†

CLYSMATICA NOVA (1665): ELSHOLTZ' NEGLECTED WORK ON INTRAVENOUS INJECTION

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III‡

CHAPTER V. *Observations by the Italians.*—Up till this time we have discussed the results our own research has afforded. There now follows what other people in other countries have discovered in their investigations.

In this work, which started not long ago, let us commence with the Italians, first at Bologna, then the tetrad of anatomical letters of Paris, the latter two of which were written by Carolus Fracassatus, an anatomist of Pisa. In them he recounts four experiments he made to establish the new art; these are retold in the *Journal de Sçavans,* or Scholars' Journal, published at Paris, for the month of August of the past year.

First Fracassatus tells how, after he had injected some common *aqua fortis,* a little weakened, into the jugular and also the crural vein of an animal, it died instantly. On dissecting the carcass, he observed that the blood was all coagulated, but more in the vessels than about the intestines. He noticed also that the larger vessels were split, just as, in those who die of apoplexy, the vessels of the lungs are generally found to be ruptured. Certainly we must conclude from this that whenever apoplexy is caused by coagulation of blood it can be cured by a suitable injection of a drug which produces dissolution.

Then he injected *spiritus vitrioli* in another animal, and this caused a slower death than the preceding liquid. The animal moaned all day, and foamed at the mouth as epileptics do, breathing quickly and heaving his chest. Nevertheless, when he died it was seen that the blood stream had congealed in his veins, but it was separated in little heaps, like soot in a furnace.

Next he injected *spiritus sulphuris* in the veins of a dog with a syringe; but even after several injections, the animal did not die. Therefore, after the wound was bandaged, he was set free in order to see what he would do. He immediately ran about, examined all the corners of the room, and, finding some bones, began to gnaw at them very greedily, as if the liquid had aroused his appetite.

Oleum tartari was injected in another dog. After repeated moaning he swelled up all over and died. When a dissection was made, it was discovered with amazement that his blood was not at all congealed, but on the contrary was more fluid and redder than usual. So it was clear that death can be caused as much by excessive fluidity of blood as by its coagulation.

Chapter VI. *Observations by the English.*—This science of simple infusion was more widely extended by the English, and a method sought by which blood could be transfused from one living being to another. Many observations of this sort can be read in the volume on the subject which the Royal Society, or Experimental College, at London is preparing now about the present argument.

Then, too, one may find in the *English Journal* the experiment of C. Dn. D. Lower, which he made at Oxford and of which he told in letters to Lord Boyle. In this is disclosed the method which he used in transfusion, through tubes made of quills, from the carotid of one dog to the jugular vein of another. It seems that the Excellent Dn. Dionysius, professor of philosophy and mathematics at the University of Paris, copied this method; but in copying it he improved it in several ways. Therefore in place of the former we shall substitute here the more recent experiment which Dn. Dionysius made on two dogs at Paris, and which he recounted almost as follows in the *French Scholars' Journal* for the current year, edited by M. Martius:

One dog was a male, the other a female. The female was full of strength and a little larger than the male; for she was twelve thumbs tall, while the male was only ten. Since we wished to preserve the life of each, we were unwilling to attempt the dangerous dissection of the carotid. Therefore we exposed the crural artery of the female, which, since it is farther from the brain and runs less deeply, may be dissected more safely. In the male, after cutting open the skin, we exposed the jugular vein.

Then two ligatures, about an inch apart, were applied to the artery. The lower of these had a knot drawn tight or firm; the higher, or the one nearer the heart, had a knot that was loose and could be easily undone. Between these two ligatures we introduced a very fine copper tube, a thumb long, and curved at one end, so that the curve was toward the heart; this was to receive the blood when the loose knot was untied. This curved end had a narrow rim around it, so that no thread which was fastened to it could slip off.

In the same way we attached two ligatures to the vein of the other dog; the distance between these was the same as in the first case, and each had a loose knot. Between these we inserted two tubes like that we used on the female, in such a way that the curve of one was turned toward the heart so that it could carry off the blood when its knot was loosened. The curve of the other was turned toward the head so that, when its knot was loosened, it would receive the blood which slipped down and empty it in a basin.

In the female, then, the artery was firmly bound to the head of its tube, and in the male, too, the vein was held fast by the two ends of the inserted tubes. Then, placing the dogs in such a position that the female's leg lay opposite the male's neck,

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† From the University of California Medical School Library.

‡ Part I of this translation of the *Clysmatica Nova* of Elsholtz was printed in CALIFORNIA AND WESTERN MEDICINE, June, 1933, page 432; Part II in July, page 45.

we inserted the first tube, which had been fastened to the artery, into the second, which had been inserted in the vein, curved toward the heart. After the three loose knots were undone, we saw not only that blood was transmitted from the crural artery of the female into the jugular vein of the male, but meanwhile that nearly as much blood as he received from the female flowed from the male into the basin placed under the third tube.

On this account I became more convinced that blood did indeed pass from the artery of the female into the vein of the male, and that it did not coagulate in the small intervening space, which was about three fingers long. For this reason I immediately ordered the first tube to be disconnected from the second. Nevertheless, we discovered that the blood which was disposed of in this manner, as if it were to remain in the pipe, both moved and was decidedly warm. Besides, its flow was very easily perceived by placing a finger below the ligature on the vein of the male, for an unusual warmth and swelling were felt there. There was no sign of this, however, when I pressed the female's artery with my finger, for, being impeded in this way, just that much less blood entered the connecting tube.

It should be mentioned here, in order to make it clearer, that a pipe made of a medium-sized quill (as depicted in Fig. III, letter *o*) is inserted between the first and second tubes. This is done (1) so that, because of the transparency of the quill, one can see more quickly if the blood is flowing properly. (2) If the tubes are too short they can be connected by adding one or more quills, as necessary.

During the operation I noticed that the third tube, which was attached to the jugular of the male, discharged far more blood than it ordinarily would have done. Without a doubt the reason was that it received through the second tube the arterial blood, which, entering the veins in a compact body in the middle of the circulating blood, necessarily emitted the same amount.

After nine ounces of blood had flowed from the male through the third tube into the basin, the female, which had lost the same amount, began to grow weak, as if she were exhausted. On this account we immediately stopped work and bound the loose knot deeply into her artery. At the same time we inserted two strong ligatures into the male's jugular vein in place of the two loose knots. And so, freeing the dogs from their bonds, we let them go.

The female, which had given the blood, was quite weak, and had only enough strength to go off in a corner of the room and stretch herself out on her uninjured side. On the contrary, the male, which had received new blood, seemed strong; indeed, when his feet were untied he tried very hard to shake off a halter which had been placed on him to prevent his barking.

A few days later this same Dn. Dionysius made another experiment, transmitting from this same male dog the blood which he had recently received from the female into a third dog; this was done very successfully. In the same way, he undertook to transfuse the blood of a young, healthy dog into an old mangy one. To repeat all of these experiments here would take too long and would be superfluous. Moreover, the accompanying illustration shows the operation itself.

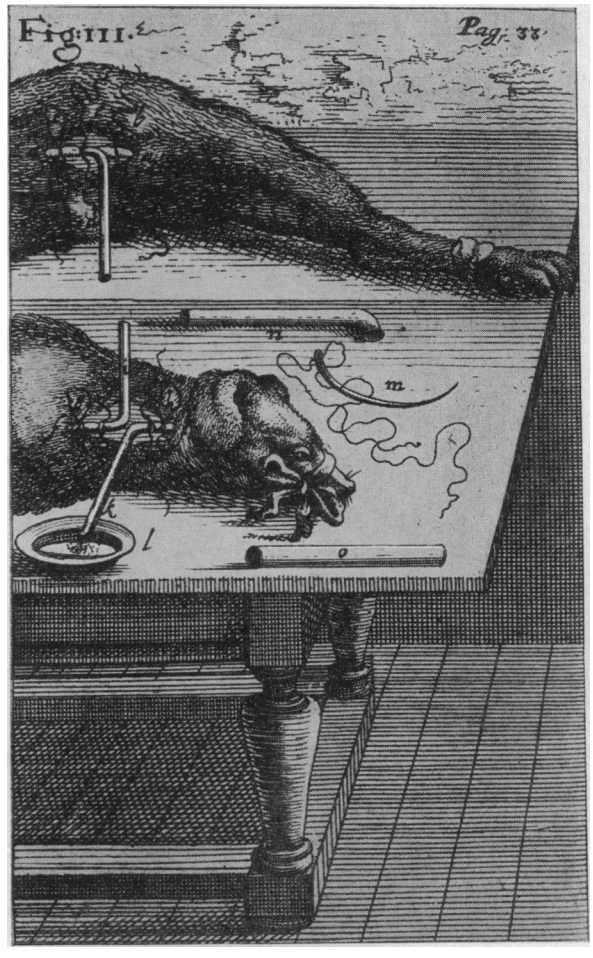

Fig. 5.—Illustration from Elsholtz' *Clysmatica* (1667), showing how blood may be transfused from one animal to another. (From a copy in the University of California Medical School Library.)

Explanation of the letters in Figure III, in which transfusion of blood from one animal to another is shown: *aa*, crural artery, exposed in dog; *b*, tight ligature; *c*, loose ligature, or with loop; *d*, first silver tube, inserted in opened artery; *e*, ligature binding artery about tube; *ff*, jugular vein, exposed in other dog; *g*, lower loose ligature; *h*, upper loose ligature; *i*, second silver tube, with its tight ligature; *k*, third silver tube, with its tight ligature; *l*, basin to receive blood; *m*, curved needle, threaded; *n*, form of silver tube with rim, for use with animals; *o*, pipe of medium-sized goose quill, inserted between first and second tubes.

Note.—Tube *n* is shown in adequate size; tubes *d*, *i*, and *k* are proportionately smaller.

Chapter VII. *Observations by the French.*—The French progressed even further; they brought blood transfusion from animals to man himself by injecting the blood of a lamb into the veins of a human forearm. The accompanying illustration (Fig. IV) shows an example of this. Dionysius has related in a letter two investigations made at Paris. The argument of his letter is also given in the *French Journal* of the past year, edited by M. Junius, almost as follows:

In short, this transfusion of blood, which some believe impossible, which very many consider most dangerous, and the majority think useless, is an actual fact and has been employed on two men. What is more, the first experiment cured a man

suffering from quite a serious disease. Because of the briefness of this study, I shall not repeat here all the things which can be said against this operation and, indeed, have been said by so many. Let it suffice to mention the primary arguments for the usefulness of this work.

First, this new art of blood transfusion must be considered as nothing else than an imitation of nature, since, to nourish the fœtus in the womb, she employs a continuous transfusion of blood from the mother to the tiny embryon, through the umbilical vein.

Second, to have a transfusion is nothing else than to be nourished in a way much more intrinsic than usual; that is, to inject in the veins blood which is already prepared, in place of food which is turned into blood only after many changes. Besides, this easy method of nourishment is seen to be preferable to the other; because food which is taken through the mouth, since it is compelled to pass through many parts of the body, some of them poorly arranged, can become infected by bad properties before it enters the veins. Therefore it is liable to various changes which could undoubtedly be avoided if prepared blood were introduced directly into the veins.

Moreover this operation reconciles disagreeing doctors, those who approve of opening the veins, and those who disapprove of it; the latter, because the operation lets out impure blood, and the former, because the strength of the patient is not diminished.

Finally, reason itself maintains that those who are weak from intemperateness of disease and from impurity of blood are necessarily cured by infusion of pure and very temperate blood.

But surely it can be seen that it is a barbarous act to save the life of one man by using the blood of another; that is, to prolong the life of the former, and cut short that of the latter. The reply to this is manifest; obviously there is no need of human blood to save a man. The blood of animals is suitable for this purpose; rather, is preferable.

Certainly men, since their minds are perturbed by varied emotions and since they too little observe right rules of eating, must have blood far more impure than that of animals, which clearly are not liable to these mistakes. Therefore the blood in animals' veins must always be pure; but in the veins of even exceptionally healthy men, blood is scarcely ever found without some taint or sign of corruption. This is true even of infants, because they, too, since they are fed by maternal blood and milk, suck in impurities together with their nourishment.

Besides, why is the blood of animals not suitable to human nature? Certainly it is not different in quality from milk or flesh, by which men are generally nourished. Nor is the decree of the Apostles in Acts, ch. xv, 29, opposed to it; for it must be known that this refers to taking blood through the mouth, not to injecting it through the veins.

For indeed, if the Anthropophagi, as writers of naval discoveries relate, are subject to many serious diseases from which their neighbours, who eat the flesh of animals, are free, it follows that as human flesh is less healthful than that of beasts, human blood also is less suitable for transfusion.

Besides, to cure diverse diseases, blood is required now warmer or colder, now thicker or thinner; just as these different qualities are more prevalent in different animals, so their blood will be better fitted for transfusion than that of men, in whom there is not such a wide diversity.

There is also this advantage—that, if anyone uses the blood of animals for transfusion, he can work with greater confidence. Moreover, he can prepare the animals beforehand through their food, suiting it to his purpose.

The first work of consequence in these experiments was undertaken on a youth about fifteen years old. He suffered from a stubborn fever, and in two months had had his veins opened twenty times. Nevertheless, although he was ordinarily of a well disposed nature and very active, he became entirely indolent, sleepy, and stupid. He nearly lost his memory; his mind grew dull; and although he slept ten or eleven hours every night, nevertheless he would lie down during the day and fall asleep, no matter whether he was eating or doing anything else which generally prevents somnolence.

The doctors judged that this lethargy was caused by a little residuary blood, which had been made too thick by the heat of the fever, and that this thickness could certainly be corrected by an infusion of new blood. This remedy being approved, a vein in the patient's forearm was opened, and about three ounces of heavy, black blood let out; then eight ounces of blood from the carotid of a lamb were immediately injected through the same opening.

The patient was well during the operation, except that he said he felt an unusual warmth all the way from the opening in the vein to the axillary; this sensation was undoubtedly caused by the heat of the flowing arterial blood. After the vein was bound up he immediately felt less sluggish, he no longer fell asleep while eating, he gradually became more cheerful, and, shaking off his torpor, regained his alertness in the following days.

Moreover, an experiment was made, through curiosity rather than necessity, on a carrier, a strong, healthy man, forty-five years old. He was given a little money, and underwent the transfusion in a happy state of mind.

Since he was plethoric, ten ounces of his blood were let out, and then in turn nearly twenty from the crural artery of a lamb were injected in him. Just as in the other case, he felt the same sort of warmth toward his axillary, but suffered very little from it. In fact, during the operation itself, he did not cease marveling at the extraordinary discovery of blood transfusion.

After his wound was bandaged, he was advised to spend the rest of the day quietly at home, and he promised to do this. But at noon he had a chance to make some money, and carried a chair as usual, asserting that he had never felt better. He also asked, if this work was to be repeated, that no one should be called upon for it except him.

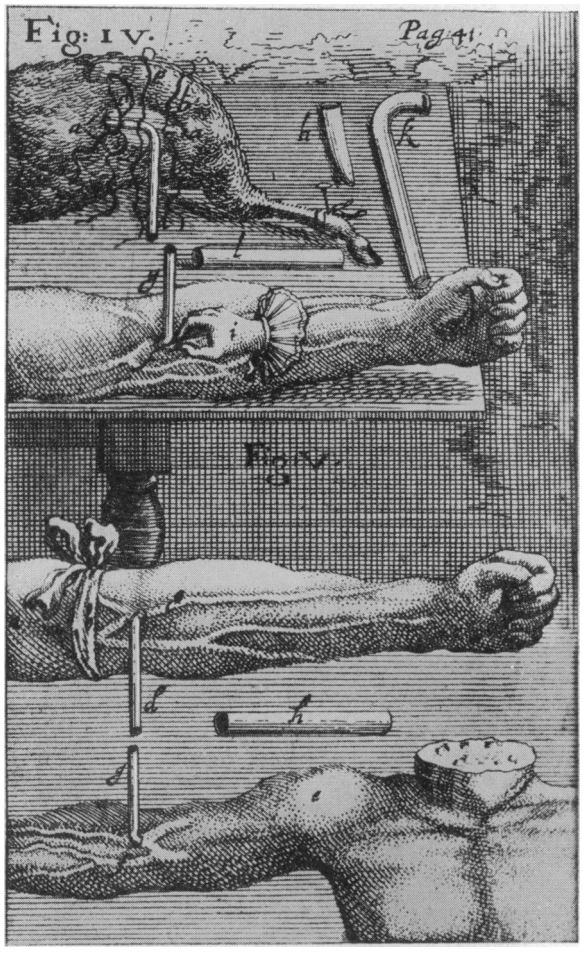

Fig. 6.—Illustration from Elsholtz' *Clysmatica* (1667), showing how blood may be transfused from animal to man, or from one human to another. (From a copy in the University of California Medical School Library.)

Explanation of the letters in Figure IV, in which transfusion of blood from an animal to a man is shown (upper half of figure): *aa*, crural artery exposed in lamb; *b*, tight ligature; *c*, loose ligature; d, first silver tube, inserted in artery; *e*, ligature holding artery about tube; *f*, median opened; *g*, other silver tube, inserted in vein; *h*, stopper for tube, made from quill; *i*, hand of surgeon, compressing skin; *k*, form of silver tube without rim, for use with man; *l*, pipe made of quill, inserted in each tube.

Note.—Tube *k* is shown in adequate size; but the proportions of tubes *d* and *g* are diminished.

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Fig. V. Transfusion from one man to another (lower half of figure): *a*, forearm giving blood; *b*, ligature around it; *c*, its median opened; *d*, silver tube inserted, and curved toward hand; *e*, forearm receiving blood; *f*, its median opened; *g*, silver tube inserted, and curved toward heart; *h*, pipe made of quill to connect tubes.

Note.—I. The hand of the surgeon compressing the skin has been purposely omitted, since it is sufficiently clear from Figure IV, letter *i*.

II. The illustrator has shown tubes *d* and *g* in small size, observing the proportions; the proper size of the others is apparent from Figure IV, letter *k*.

III. Three types of incision with a lancet can be made, according to size; that is, small, medium, and large. Therefore it should be observed that the medium alone is completely suitable to tube *k* in Figure IV. For the small incision would not admit the tube which should be inserted, and the large would waste too much blood.

IV. If a correct proportion is observed between the incision and the tube, so that the latter fits exactly into the opening, there is scarcely any need of compressing the skin; it is sufficient to place a very little cotton around the opening.

V. If, because of a rather large incision, compression is necessary, it should be moderate, and done without puckering up the skin; otherwise the flow of blood is completely checked.

VI. Of course, for a larger incision, heavier tubes can be used; but experience shows that all liquid vibrates more strongly and for a longer time through a narrower tube.

VII. The blood in the forearm of the person giving it should not be thick but thin and fluid in nature, because when this is so, since it has been subject to friction in the warm metal, it can then enter the blood stream more fittingly. Once, when the first blood, because of its thickness, went through the inserted tube poorly, I ordered the tube to be withdrawn, and several ounces of the heavier blood let out. When this had been done and the tube was reinserted, we noticed that the succeeding thinner blood passed through it easily.

VIII. The type of man to give part of his blood to a weaker person must be strong, young, and plethoric, and have blood which is suitable for vibration. For when transfusion takes place between two weak people, or when the existing blood is too thick, the operation either will not succeed at all or will proceed less fortunately.

Indeed, in the month of October, when this present little book was imprinted, a Latin version of the *French Journal,* in two volumes, issued at Lipsia (Leipsic) before the last autumn market day (nundinas), was brought to us. At the end of the second volume, in the forty-second ephemeris, the following observation is related from the letters from Paris.

"It is not long ago," says the author, "that the doctors attempted a new experiment on a certain noble Swede, whose life was despaired of. Although he was then half dead because of a fever, together with bilious diarrhœa and a weak liver, he was restored during a transfusion of blood from a calf, so that he could speak again and understand words. Nevertheless, two days later, since his intestines were decayed and the ileum had turned back on itself from top to bottom so that it was impossible for him to live, he breathed his last.

"Moreover, under Duke Guisius, the blood of two rams was infused in an old horse, which then became strong and vigorous."

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Chapter VIII. *Experiments Made at Borusia.* At this point I cannot forbear to make most honorable mention of Cl. Virus D. Jo. Dan. Major, state professor at the Academy of Kiloniens, who, in 1664, published a treatise about the present subject, entitled "The Labor Involved in Employing Surgical Infusion." In this he expounded his ideas learnedly and accurately for posterity, and he deserves great praise on this account. For the rest we wish to say—with due respect to the author—that there are people who consider this book merely theoretical, and particularly feel the lack in it of experiments made by the writer himself.

For it is clear that arts are not completed by theorizing alone. If they were, and if we had wished to obtrude on the world our ideas alone, without proof, we could have completed our little book on this work without difficulty and in the ordinary manner in that same year, 1661, in which, through the anatomical help mentioned in Chapter II, we had both the opportunity and the occasion.

Moreover, this same D. Dan. Major, in the present year, 1667, composed in common right his *Winter Pleasures,* or *Three Medical Discoveries,* in which he tries sedulously to prove that he discovered this new science at the same time that we did, and he reproaches us, in a friendly manner, because we made no mention of him in the first edition of our *Clyster.* Surely I am blameless,

since he had not done anything in connection with his *Surgery,* when my *Observations* had long been both made and told in letters; otherwise he would never have felt the want of the increasing praise of an eminent friend. Besides, I do not see in his *Pleasures* any experiments which I can cite here, except those foreign Gedanensian ones, whose history Dn. D. J. Mollerus, a Dantiscan doctor, has reviewed in letters from Dantisci, dated February 27, 1666, to a friend in Hamburg. A translation of his German words follows:

Two sick people in our community perceived the very great usefulness of this new discovery. The first was a soldier, so badly infected by syphilis that no cure could free him of this plague. He had ulcers on his tibiæ, his right forearm was swollen and drawn up, and the pain in his head was so severe that he shrank from the touch of a hand on it. The Gedanensian doctors brought speedy relief to him by the infusion of a certain liquid in a vein; within twenty-four hours not only the pain in his head but also the tumor and the paralysis of his forearm had completely disappeared. Moreover, in three days the ulcers had healed without the application of plasters.

Furthermore, a serving maid, who from birth had been subject to epilepsy, through the help of the good Lord and the power of this remedy, regained her health so that after several months she was completely cured of this disease.

Certainly, unless some subtle person has doubts about the credibility of this narrative, it must be confessed that these two cures recounted by D. Mollerus are far superior to all those which have been made at Paris.

(To be concluded)

Lord Moynihan's Tribute to W. W. Keen.—One of the things in which Lord Moynihan excels is a keen sense of the personal qualities of his compeers, and in the grace with which he can express it. Writing to the *Lancet* on the news of the death at the age of 95 of his "very dear old friend Dr. Keen," he says: "His eagerness in every form of intellectual pursuit never ceased to astonish his friends, sometimes even perhaps to embarrass them, for in pursuit of knowledge he spared no man. . . . His textbook of surgery was the first in our language to be based on bacteriology; it almost alienated our affections from 'Erichsen.' Many men considered him—though having heard Nicholas Senn and J. B. Murphy, I could never agree—the greatest teacher of clinical surgery America had ever known. His virility and force were well matched with sincerity and invulnerable accuracy, and tempered with sobriety." He was the protagonist of our ideas on vaccination, vivisection and laboratory research. "He was a man of decided views emphatically expressed; but he was, no less, the very flower of culture, the very perfume of courtesy. He had the happiest knack, excelled not even by Osler, of keeping in touch with his friends in all lands. It was justly said of Osler that many men in many lands hugged the belief that they were his particular cronies. That was certainly true of Keen." Coming to technical matters: "His work on the brain, nervous sytem, abdominal organs, upon the ravages of typhoid fever in their surgical relations, indeed upon all branches of surgery—and he practiced all with immense success—was perhaps the most considerable and the most inspiring of that of any surgeon in the states."—*Journal of American Medical Association,* Vol. 99, No. 4.

CLINICAL NOTES AND CASE REPORTS

SKELETAL TRACTION

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THE development in the application of skeletal traction methods in the field of fracture surgery has been one of the noteworthy advances in the last few years. I should like to present here certain accepted methods and discuss their advantages and disadvantages, the wide variety of their uses, and also certain points in technique which more recent experience has brought out. The variety of instruments now in use are as follows: the Steinman pin, the ice tongs, the rigid stainless-steel pin, and the taut piano wire.

INSTRUMENTS

Steinman Pin.—The Steinman pin has the advantages of being removable both ways, thus preventing contamination of the wound. Its disadvantages, as have been found, are that it is weak and will frequently, under traction, bend or break at its central telescoping joint. This is a serious defect.

Ice Tongs.—In the case of the ice tongs, they would seem to have some advantages over other methods since they do not go entirely through the bone. They have, however, been largely discarded because of their tendency to slip or drag. There is difficulty in holding them immobile. They are not fool proof. The patient or his friends can often disturb them seriously.

Rigid Steel Pin.—The rigid steel pin has some followers. In many ways, I prefer it. The size and strength can be adjusted readily to the needs. It may bend under extreme stress, but it does not break. A disadvantage, of course, is that one end must be rendered aseptic when the pin is removed. This, however, is not difficult. A thorough cleansing, followed by ether and iodin, is sufficient in my experience.

Taut Piano Wire.—The taut piano wire is the newest method developed in this field. The original schemes for insertion of the piano wire, were quite complicated, but this recently has been overcome. Now the wire whose end has been shaped as a drill, can be fed through a simple appropriately designed brace and very readily placed. The advantages of the very small wire in the case of the smaller bones is evident. The radius, the ulna, the metacarpals and phalangeals, can be readily drilled with the wire. The size of the wound also recommends it. The objections brought forward are twofold. First, the wire is so small that it might pull through the bone under continual stress; I have not found this to be the case. Second, when this method is used in conjunction with rigid plaster fixation, the collar which keeps the wire under tension must be left in place. This is awkward. Also, as in the stainless-steel pin, when the wire is removed one end must be sterilized.